Photosynthesis in Higher Plants

11 Chapter

1. By looking at a plant externally can you tell whether a plant is C3 and C4 ? Why and how?

Ans. A plant's external appearance cannot tell us if it is C3 or C4. A plant that lives in a dry climate, however, follows the C4 pathway. A C4 plant's leaves differ from C3 plants in several ways, but only at the cellular level can these differences be seen.

2. By looking at which internal structure of a plant can you tell whether a plant is C3 or C4? Explain.

Ans. C4 leaves possess certain anatomy known as Kranz anatomy, which sets them apart from C3 leaves. Plants of the C4 family have special vascular sheath cells surrounding their bundles of vascular cells. Chloroplasts are abundant in these cells. There are no intercellular spaces in them, and their walls are thick. The internal structure of a plant lets us determine if it is C3 or C4.

3. Even though a very few cells in a C4 plant carry out the biosynthetic – Calvin pathway, yet they are highly productive. Can you discuss why?

Ans. A C4 plant does not undergo photorespiration because its enzyme site accumulates CO2 by itself, making photorespiration impossible. By breaking down C4 acid in the cells of the bundle sheath, the CO2 that is released gives rise to an increase in intracellular concentration. Ultimately, this ensures the RuBisCO is an efficient carboxylase, and that oxygenase activity is minimized. Photosynthesis rates thus increase, increasing the productivity of C4 plants.

4. RuBisCo is an enzyme that acts both as a carboxylase and oxygenase. Why do you think RuBisCo carries out more carboxylation in C4 plants?

Ans. Plants of the C4 family lack the enzyme RuBisCo. Bundle-sheath cells surround vascular bundles rather than contain this protein. As a result, in plants with C4 cells, Calvin cycles do not take place in bundle-sheath cells. CO2 is mainly accepted into cells of the mesophyll by phosphoenol pyruvate, which is a three - carbon compound. In this reaction, it is transformed into

oxaloacetic acid (OAA), a four-carbon compound. Further conversion of OAA to malic acid occurs. The Calvin cycle links malic acid to CO2 by decarboxylation in bundle-sheath cells. RuBisCo can no longer function as an oxygenase because of this.

5. **Suppose there were plants that had a high concentration of Chlorophyll b, but lacked chlorophyll a, would it carry out photosynthesis? Then why do plants have chlorophyll b and other accessory pigments?**

Ans. Because chlorophyll a is the chief pigment associated with photosynthesis as it traps light, a plant that lacks this pigment would not be able to carry out photosynthetic activity. The other accessory pigments, such as chlorophyll b, xanthophylls, and carotenoids, are equally crucial to the process of absorption of light and energy transfer to chlorophyll a. Moreover, they reduce photooxidation of chlorophyll a while enabling a wider wavelength range to be utilized for photosynthesis.

6. **Why is the colour of a leaf kept in the dark frequently yellow, or pale green? Which pigment do you think is more stable?**

Ans. The green pigment chlorophyll is unable to absorb light without light, therefore losing its stability. The leaves thus change from green to yellow. Xanthophyll and carotenoids are some of the more stable accessory pigments.

7. **Look at leaves of the same plant on the shady side and compare it with the leaves on the sunny side. Or, compare the potted plants kept in the sunlight with those in the shade. Which of them has leaves that are darker green? Why?**

Ans. Leaf surfaces in shade receive lesser sunshine, so they experience a lesser amount of photosynthesis than plants or leaves in direct sunlight. Leaf pigments present in shady areas increase photosynthesis. As the chlorophyll content increases, the leaf absorbs more light, leading to a greater amount of photosynthesis, which makes the leaves greener when in shade than when in sunlight.

8. **Given below figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following questions:**
   (a) At which point/s (A, B or C) in the curve is light a limiting factor?
   (b) What could be the limiting factor/s in region A?
   (c) What do C and D represent on the curve?

Ans. Light intensity and photosynthesis rate graph

(a) In the given graph, light serves as a limiting factor where photosynthesis occurs to the lowest degree. As a result, light is limiting at point A.
(b) Light can limit the growth of plants; water, temperature, and carbon dioxide concentration are also factors.
(c) At stage C, light is no longer a limiting variable. Photosynthesis has already reached its highest rate at point D when light intensity no longer affects photosynthesis.

9. Give comparison between the following:
(a)C3 and C4 pathways
(b) Cyclic and non-cyclic photophosphorylation
(c) Anatomy of leaf in C3and C4 plants

Ans.

(a) C3 and C4 pathways

C3 pathways	C4 pathways
CO2 is mostly accepted by RUBP, which is five carbons.	phosphoenol pyruvate - a chemical compound with three carbon atoms - is the primary acceptor of CO2.
3-phosphoglycerate is the first stable product.	Oxaloacetic acid is the most stable of the products.
Leaf mesophyll is only found in leaves.	Leaves contain bundle-sheath cells and mesophyll cells.
This process of carbon fixation takes a long time, and photorespiration losses are high.	Photo-respiration losses are low and it is a faster carbon fixation process.

(b) Cyclic and non-cyclic photophosphorylation

Cyclic photophosphorylation	Non -cyclic photophosphorylation
It is restricted to photosystem I.	Photosystems II and I each contain this protein.
The only process involved is the synthesis of ATP.	ATP and NADPH2 are synthesized during this process.
Water is not photolyzed in this process.During this process, water undergoes photolysis.	

Oxygen is liberated from the photosynthesis process.	A higher plant cannot perform photosynthesis. As a result, oxygen is not produced.
Electrons move in a closed circle during this process.	This process does not involve electrons moving in a closed loop.

(c)Anatomy of leaf in C3 and C4 plants

Anatomy of leaf in C3	Anatomy of leaf in C4
Bundle-sheath cells are not seen.	Bundle-sheath cells are found
RuBisCo is found in the mesophyll,	Cells contain RuBisCo.
It was three-phosphoglycerate, a compound with three carbons, that was produced first.	It produces oxaloacetic acid, a four-carbon compound, as its first stable product.
Photorespiration takes place	Occurs in the absence of photorespiration